

BEER

Human History and Beer

Beer is a starch-based alcoholic beverage produced without distillation. Beer is usually brewed from barley malt, and other grains such as rice, corn, wheat, or oats thrown in for reasons of cost, texture, or tradition, and seasoned with hops. This is just for starters. Throughout human history many other variations of starchy vegetable product have been used, even manioc (tapioca) and millet (small seeded grasses).

Beer history begins just after the glaciers of the last ice age retreated northward, around 12,000 years ago. The Neolithic people in the hill country of current day Kurdistan (**SLIDE 2**) start to use grasses as a good source of nutrition. Eventually these grasses evolve into barley and wheat and the beginning of agriculture, and creating a change from the nomadic human lifestyle of herding in search of pastures from season to season. It is thought by historical scholars that beer led early humans to come together in unnaturally crowded settings, like cities.

Wine and beer developed at about the same time and place. Wine was considered a more luxurious drink and reserved for royalty and upper-crusted types. Everyone drank beer.

The Sumerians were the first great civilization of the Middle East, and they enjoyed their beer. Their word for beer, kas, literally means “what the mouth desires,” and indicates how central beer was to their culture.

By 5,000 years ago, the art of beer was well established with an expansive vocabulary of ingredients, brewing vessels, and types of beer. Malt kilns made red, brown, and black beers possible. There were various types, such as fresh and aged, strong and weak, and even a diet beer. Yeast was already known as the stimulus of beer, but its true nature would remain a mystery until the 1830's. When the ground breaking work of Louis Pasteur, and other scientists observed and described the living nature of the yeast cells.

Women were the brewers as well as the sellers of beer, (**SLIDE 3**) similar to Europe throughout the Middle Ages. Barley grain was malted, kilned, and ground. It was then either formed into conical cakes and baked, or used as is. Baking the cakes added some carmelization. The cakes would have been added to hot water to get the brewing started. People drank their beer out of a

communal vessel through long straws, typically made of reeds. **(SLIDE 4)** High-status individuals would have had straws made of more precious materials.

Ancient Middle Eastern people, such as the Babylonians, Akkadians, and Hittites were also beer lovers. The Semitic people, referenced in the bible, were not that fond of beer. Wine is mentioned frequently in the bible, and something called shekar translated as “strong drink,” but it is not clear if this was beer or something else.

Not too far away in Egypt, beer was brewed on a grand scale. Breweries were associated with temples there and similar in size to brewpubs today. Beer, along with bread and onions, is credited with fueling the vast construction projects like the Pyramids. As in Mesopotamia, beer was often brewed from specially prepared cakes of malted barley, bottled in tall clay jars with clay seals.

The Greeks had no great use for beer, but the Lydians and Phrygians to the north were lovers of the brew. Evidence of this comes to us by way of their famous ruler, King Midas, **(SLIDE 5)** who ruled about 700 BCE. In the 1950's, archeologist's dug down through an ancient mound in Gordion, Turkey into a heavy timber structure finding the burial site and the remains of a funerary feast for the king. These objects were put on display and later a professor from the University of Pennsylvania, Patrick McGovern, used molecular archeology to research the ancient foods and drinks removed from the cauldrons and drinking vessels. To announce the results a party was held and Sam Calagione of Dogfish Head Brewery was asked to make the beer. It has evolved into a regular product called, Midas Touch. It is impossible to say how well this modern brew resembles the ancient version, but it gives us a glimpse into the lives of these ancient, beer-loving people.

Like the Greeks, the Romans never did warm up to beer. There is a line **(SLIDE 6)** south of which grapes grow well and wine is the dominant drink. North of this line there are enthusiastic beer drinkers. The seasonings of these ancient northern beers consisted of juniper, honey, cranberries, and an herb called meadowsweet. Grapes and raisins were sometimes used to kick-start the fermentation process in beer. Sculpted images of poppy pods suggest that opium was involved in some rituals. The Scythians, **(SLIDE 7)** in the present day Ukraine, enjoyed hemp, and the Greek writer Herodotus writes about sauna-like tents with heated rocks inside that hemp seeds were tossed giving off a vapor unsurpassed by any vapor-bath available in

Greece. To the west in the British Isles, beer is seasoned with heather by the Picts, the original inhabitants of the islands and responsible for Stonehenge. They were later displaced by the Celts.

Prior to 1,000AD, almost all beer in Europe was brewed without hops, it was seasoned with a pricey mixture called "gruit" (**SLIDE 8**) and sold by the holder of the local Gruitrecht, or "gruit right." The holders were usually a circle of big wigs, such as the church, state, or in-between. It is not known what gruit consisted of, as it was a big secret. The seasonings were mixed with ground grain making it difficult to counterfeit. Some herbs in gruit are thought to be bog myrtle or sweet gale, yarrow, and wild rosemary in addition to other available seasonings such as cinnamon, nutmeg, juniper, ginger, caraway, and aniseed.

Around 1,000AD, the first hopped beers appear in the north German Hansa Trading League City of Bremen. (**SLIDE 9**) These early adopters of hops were "free" cities beyond the reach of the church and as such not obligated to use gruit. At the time, brewers of gruit beer were known as "red" beer brewers making brown or amber-colored beers. Those using hops brewed "white" beer that included a fair amount of wheat in the grist along with the barley.

The brewers of Bremen and nearby Hamburg shipped a lot of beer to Amsterdam. Over time the local brewers figured out how to brew the hopped white beer, and began exporting to Flanders or northern Belgium, repeating the cycle once again. By the year 1500 this hopped beer had made its way to England with a flood of Flemish immigrants leaving northern Belgium. Hopped beer was successful not only because of its taste, but also due to the hops preservative properties that retard certain beer-spoiling properties. This allowed table-strength beer to remain drinkable for a few months rather than a few weeks. By the year 1600, all English beer had hops to some extent. Eventually, all of northern Europe was flourishing, and hopped beer was the norm.

Numerous changes in Europe would culminate in the Industrial Revolution. Many large public works projects began in England in the mid-seventeenth century such as opening canals and improving harbors. (**SLIDE 10**) These changes effected brewing as they improved availability of raw materials and opened distant markets. People were moving from the fields and into the cities.

A brown malt was becoming popular in London in the late 1600's and brewed at different strengths by aging for longer periods. Bar patrons enjoyed ordering blends of two, three, or even five of these separate malt beers. As the story goes, best known as the "three threads" myth, **(SLIDE 11)** porter was invented by Ralph Harwood in his Bell Brewery in Shoreditch, located in the east end of London, to replace these brown malt blends in the 1720's. This new hoppy brown porter beer was a big success aided by new technologies and inciting the development of the largest breweries ever known up to that time. In 1810, London porter breweries brewed 1.2 million - 36 gallon barrels. At the time it took large sums of money to finance a brewery, second only to banking.

The transition to cold-fermented lager brewing is not real clear. The reasons are a mix of the influence of beers imported from farther north and brewing limited to the colder half of the year. A common story of Bavarian monks fermenting in Alpen caves is plausible, but there is little to support it. There is sketchy documentation in early records from Munich, dated 1420, about brewing lager. Then text was found in the city of Nabburg in northeast Bavaria, bordering on Bohemia; "One brews the warm or top fermentation; but first in 1474 one attempted to brew by the cold bottom fermentation, and to preserve part of the brew for the summer." It is thought that by the year 1600 lager was pretty dominant in Bavaria and nearby regions such as Bohemia.

Due to their clean pure flavors lager's benefit from the consistency of single-cell yeast cultures, so German brewers were quick to adapt them. English brewers of that time tried them out and due to their short brewing cycle found them unnecessary; mixed yeast cultures are still used today in some English breweries.

In 1842, in the town of Plzen (Pilsen) of the Czech Republic in northern Bohemia, **(SLIDE 12)** many things came together for them to create a beer that would eventually dominate the world market. The beer, Pilsen, was a gathering of ingredients, technology, and a business plan just right for the times. Community leaders decided to bet big and build a sizable brewery to make lager beer and capitalize on the lager boom underway and the high quality malt and hops available in the region. The pale, crisp, effervescent Pilsner beer was a big hit, bringing Plzen worldwide celebrity status.

In 1871, Bavaria joined the German Union, bringing its restrictive beer purity law with them. By 1879, this Reinheitsgebot had the force of law across Germany. Prior to this, northern

Germany's beers had more in common with Belgium than Bavaria. It was white-beer country up north, beers were brewed with a proportion of wheat, often smoked, sometimes sour, and using herbs such as coriander, and sugars such as molasses and honey, and very popular. Of all these northern German ales, only Berliner Weisse and the specialty ales of the Rhine Valley, Kolsch and Dusseldorfer Alt have survived in any meaningful way. By the time World War II was getting started, all of the classic Germanic lager styles as we know them today were well established.

Technical Changes of the Industrial Revolution

With the onslaught of the Industrial Revolution, there were numerous technological changes that occurred and many had an impact on brewing.

Steam powered engines (**SLIDE 13**) were developed about 1700 and used for mining at the time. With the improvements made by the Scottish inventor James Watt and others steam engines were first installed in London breweries in 1784. This form of power replaced manual, water, and horsepower for various tasks and made large scale industrial brewing possible.

Providing a consistent means to measure temperature was brought about with the thermometer. (**SLIDE 14**) Daniel Gabriel Fahrenheit, from a wealthy German Hanse family, created the first mercury thermometer and the standardized *Fahrenheit* scale in 1714. The *Celsius* scale was developed in 1742. The thermometer allowed for more consistency than earlier empirical methods as well as detailed research into the dynamics of brewing procedures.

In 1785, John Richardson wrote the first brewing book detailing brewing measurements made using a hydrometer. (**SLIDE 15**) This is an instrument that measures specific gravity and is used to measure the amount of sugar and other dissolved solids in beer *wort* (*wert*). Wort being the sweet liquid drained from the mash that is fermented to make beer. His book had huge implications for the way beer was brewed and more importantly how beer tasted. It enticed brewers to formulate their recipes with the outcome in mind.

Yeast is essential for the fermentation in beer. (**SLIDE 16**) Yeast metabolizes the sugars extracted from grains, which produces alcohol and carbon dioxide, and thereby turns wort into beer. It also influences the character and flavor. The dominant types of yeast used to make beer are the top-fermenting for ales and the bottom-fermenting for lagers. During the 1830's

researchers first observed and described yeast cells and revealed their living nature. For the first time a single-cell culture of yeast was produced as opposed to a mixed-brewing culture. Brewing with single-cell cultures of yeast makes for a more consistent and on average a better beer. This approach caught on slowly, and by the mid-twentieth century it was the norm. Before the role of yeast in fermenting was understood, fermentation involved wild or airborne yeasts. A few beer styles, such as lambics, still rely on this method.

Refrigeration is a great improvement over ice cut from frozen rivers and lakes. **(SLIDE 17)** Commercial refrigeration was first developed during the 1850's. The first refrigeration machines, designed by the German engineer Carl von Linde, were installed in Munich at the Spaten Brewery in 1873. Not only were the logistics of using natural ice complicated, but it was becoming a health hazard due to pollution of the waterways. By 1890, artificial refrigeration was the norm for large-scale brewers everywhere.

Prior to the industrial revolution malt kilning used direct-fired, wood-fueled kilns. A gradual transition occurred to indirectly heated kilns fueled by coal, coke, or other fuels. By 1700, most breweries had switched to smoke-free malts. The most dramatic invention regarding malt kilning was the cylindrical roaster patented by Daniel Wheeler in 1817. **(SLIDE 18)** It used a cooling spray to stop roasting before the grain caught fire. This device drastically changed the brewing and flavor of porter and stout, since a small amount of this much darker malt was more economical than the large amounts of brown and amber malts used earlier.

Brewing Process

Now that we have a general understanding of beer and its relationship with human history, let's move onto the actual brewing process for beer. There are several steps in the beer brewing process and these include malting, mashing, lautering, boiling, fermenting, conditioning, filtering, and packaging. The actual steps used are dependent on the specific beer style being brewed, and there are many.

Malting is the process where the grain is made ready for brewing. **(SLIDE 19)** Malting is broken down into three steps to help release the starches in the grain. First, during steeping, the grain is added to a vat of water and allowed to soak for about 40 hours. During germination the grain is spread out on the floor of the germination room for around 5 days. The final part of the malting process is kilning when the malt under goes very high temperature drying in a kiln. The

temperature change is gradual so the heat doesn't damage the enzymes in the grain. When kilning is complete, the grains are now referred to as malt, and they will be milled or crushed to break apart the kernels and expose the cotyledon that contains the carbohydrates and sugars for extraction during mashing.

During the mashing process, the starches released during the malting stage are converted into sugars that can be fermented. The milled grain is mixed with hot water in a large vessel called a mash tun to create a cereal mash. During this process, naturally occurring enzymes present in the malt convert the starches in the grain into smaller molecules or simple sugars. The conversion is called saccharification, resulting in a sugar rich liquid or wort (*wert*). This fluid is then strained through the bottom of the mash tun in a process called lautering. Prior to lautering, the mash temperature may be raised to about 165 to 170 degrees F, known as a washout, to deactivate enzymes. Additional water may be sprinkled on the grains to help extract additional sugars, a process known as sparging.

The wort is transferred into a large tank known as a "copper" or *kettle* where it is boiled with hops and sometimes other ingredients such as herbs or sugars. During this stage various chemical and technical reactions take place, and it is when important decisions about the beer's flavor, color, and aroma are to be made. The "boiling" process terminates enzymatic processes, accelerates proteins, isomerizes or begins molecular transformation of hop resins, and concentrates and sterilizes the wort. At the end of the boil, the hopped wort settles to purify in a vessel called a "whirlpool," where the solid particles separate out.

After the whirlpool, the wort begins the cooling process. It is transferred rapidly from the whirlpool or brew kettle to a heat exchanger for cooling. It is very important to quickly cool the wort to a level that yeast can be added safely since yeast cannot grow in a hot solution. After cooling in the heat exchanger, the wort goes into a fermentation tank. A specific type of yeast is added, or "pitched," into the fermentation tank. When the yeast is added it is the start of the fermentation process, when the sugars turn into alcohol, carbon dioxide and other components. When the fermentation is complete the brewer may rack the beer into a new tank, called a conditioned tank. The beer conditioning or maturation process ages the beer and the flavor becomes smoother, and unwanted flavors will dissipate. After conditioning for a week to several months, the beer may be filtered and force carbonated for bottling, or fined in the cask.

Packaging is putting the beer into containers to be transported from the brewery. This may be in

bottles, aluminum cans and kegs or casks, and it may also include bulk tanks for high-volume customers.

Beer Styles

There are those in the brewing community that are annoyed at the notion of beer styles.

(SLIDE 20) “Beer is art in fermented form,” and any attempt to limit it to preordained categories diminishes its greatness. They say that styles are nothing more than a crutch for unimaginative minds.

But styles are a reality. They exist in history, in the marketplace, and in some places have the force of law behind them. Brewers brew by them, consumers buy by them, and competitors are judged by them. Styles honor the past and give order to the present and help people wrap their heads around the complexities of beer.

So what are the attributes that create the combination of qualities to create the numerous beer styles? First, these attributes shall be measurable such as; color, gravity, alcoholic strength, bitterness, attenuation (the percent of sugar converted to alcohol and carbon dioxide by the yeast), and others. In addition, there are the subjective attributes like aroma, flavor, texture, and mouth-feel. These measurable and subjective attributes do not tell the full story or explain how a style came into use, through whom, and for what purpose. There is a deeper, richer level involving technology, geography, and culture that gave rise to these various styles of beer. Understanding them and seeing beer styles in their proper historical context is essential to grasping the bigger themes and the essence of a beer style. This allows both the brewer and the drinker to celebrate these styles at a higher level.

Historically, many styles develop spontaneously and only later on get the name they become famous for. Dark brown ales were brewed in London for a generation before the name “porter” was applied to them around 1725. “Stout” was a term used generically for strong beer in England in the late 1600’s, but it didn’t find common use until a generation later, when it was known exclusively as a strong porter.

Other beers are the product of invention, not evolution. Pilsner dates quite precisely to 1842, when the city fathers decided to build and brew a pale beer, then a new idea in the lager world.

So what are these beer styles? There are basically three; top fermenting ales, bottom fermenting lagers, and a hybrid/mixed style. Ales are by far the oldest types of beer. Ale production can be traced back more than 5,000 years. They are fermented and served at warmer temperatures, usually yielding more intense flavor profiles. Depending on the brewing style, they can be their best when only a couple of weeks old or several years old. Lagers have only been around for several hundred years. They were not fully understood until after the invention of the microscope. The yeast strains that make them were originally propagated by accident. They are fermented and served at cooler temperatures. This limits the formation of esters and other fermentation by-products, producing a clean flavor. Lagers are the most popular large brewery beers in America, although the version most often consumed here is nothing like the European version.

Brief Listing of Ale Style Beers

(SLIDE 21)

Abbey Beers (Belgium) - The term "Abbey ale" refers to the brewers having a relationship with a monastery than it does with a specific beer style. The following sub-categories are just as hard to define clearly.

- Single
- Dubbel
- Tripel
- Quadrupel

Barley Wine (England/Scotland)

Beliner Weisse (Germany)

Bier de Garde (French)

Bitters (English)

- *Ordinary bitter*
- *Special bitter*
- *ESB (Extra Special Bitter)*

Brown ales (Belgium & England)

- *Belgian Browns*

- *English Browns*

Dunkel Weizens (Germany) - “Dunkel” means dark. “Weizen” means wheat. In addition to clove and banana-like esters, these wheat beers are also famous for raisin and caramel flavors. More common in southern Germany, this style of wheat beer is highly carbonated with low hop character and brewed using at least 50% malted wheat. They’re usually unfiltered, and if so would include the prefix “Hefe” on the label. They tend to be of medium strength, but can be as high as 8% ABV (alcohol by volume).

Golden / Blonde (Belgium)

Hefe-weizen (Germany) - “Hefe” means “unfiltered” or “with yeast”. Clove and banana-like esters produced by particular strains of brewing yeast are signatures of this style. German style wheat beers are highly carbonated, have low hop character and are brewed using at least 50% malted wheat. Sometimes they are called “Weissbiers,” or white beer. This is a reference to the light color of the beer and head.

India Pale Ale-IPA (England) - The stars of the hop world. As with a number of brewing styles, IPA was born out of necessity. When the British were colonizing India, the beers they sent down to their troops kept spoiling during the long sea voyage. With an extra healthy dose of hops and alcohol (40-65 IBU and 5% -7.5% ABV respectively), both having great preservative value, their problems were solved, and the world had another distinctive beer style. Today, American craft brewers do more than emulate the style. They continue to push the envelope with strength and bitterness.

Lambics (Belgium) - Lambics represent the oldest style of beer found in the modern world. Specific to the Brussels area, this style resembles wine and champagne more than any other beer in the world. The name is most likely derived from the small town of Lembeek (“Lime Creek”), southwest of Brussels in the Zenne River valley. This is the heart of the Lambic region. A handful of breweries around Lembeek practice brewing methods which pre-date the culturing of yeasts. They gain their tartness from a content of at least 30% raw wheat in addition to malted barley, but their defining characteristic is the use of wild yeast, or “spontaneous” fermentation. Wild airborne yeasts, indigenous to the region, ascend upon open brewing vessels in attics of farmhouse breweries, where nature takes its course. It is not uncommon for Lambics

to have a fermentation period of two or three years, and much of that time in wooden casks. Most of these beers have conventional alcohol content, in the range of 3%-6% ABV.

- Fruit Lambic
- Gueze (Champagne style)
- Straight Lambic

Porters (England) - Porters were the first beer style in the world to achieve national distribution, due to the industrial revolution. The style can be dated to the early 1700's. It has been argued that porter takes its name from the train porters who used to sell their beer throughout the early British rail system. Another notion is that porter was first produced on a commercial scale in London on the River Thames, where it was sent out on ships bound for other port towns. The darkness of the beer covered up cloudiness and the roasty full flavor helped mask flavor defects. These were helpful beer style characteristics during a period when problems with consistency in brewing were commonplace. Today, porters range from 4% -6.5% ABV.

Red Beers (Belgium)

Saison (Belgium)

Scotch Ale (Scotland)

Scottish Ales (Scotland)

- *Scottish light ales*
- *Scottish heavy ales*
- *Scottish export ales*

Stouts - Come in five major categories, Irish Dry, Sweet (Cream), Oatmeal, Foreign and Imperial. Stouts are black in color with the exception of oatmeal and imperial stouts, which can vary from dark copper to black.

Strong Ales (England)

Trappist Beers (Belgium / Dutch) - This term is properly applied only to a brewery in a monastery of the Trappists, one of the most severe orders of monks. This order was established at La Trappe, in Normandy. There are seven Trappist breweries, six in Belgium and one just across the Dutch border. Trappists who left France after the turbulence of the Napoleonic period

established all of them. The Trappists have the only monastic breweries in Belgium, all making strong ales with a re-fermentation in the bottle. Some gain a distinctively rummy character from the use of candy-sugar in the brew-kettle. They do not represent a style, but they are very much a family of beers.

White (Wit) Bier (Germany)

Winter Warmers (Various Countries)

Brief Listing of Lager Style Beers

Bock (Germany) - Bockbiers are strong beers that can be traced to the town of Einbeck Germany, from the year 1250. They were originally spontaneously top fermented dark beers primarily made of wheat. Einbeck is also one of the areas responsible for the propagation of lager yeasts that have become commonplace in the modern world.

- *Helles bock / Maibock – Light bock beer*

Doppelbocks (Germany or Paula, Italy) - Contrary to popular belief, it has been argued that doppelbocks are not really related to bocks, other than by name. They come from a different place and time in history. During the Protestant Reformation (Circa 1517), the Franciscan monks from Paula Italy settled in Munich. These monks would ritually brew strong beer to carry them through the two holy fasts of Lent and Advent. While the beer style can be dated to the 1500's (which makes them a few hundred years younger than bocks), it didn't even get its name "dopplebock" until the early 1900's, when it became a popular style in Munich. The people, comparing it to the immensely popular bockbiers of the day, noticed the difference in color and strength, subsequently giving it the moniker "doppelbock" (double bock).

- *Traditional bock*

Dortmunder / Export (Germany)

- *German Helles*

Munick style dunkels (German dark lagers)

Pilseners

- *Czech Pilseners (city of Plzen (Pilsen), Czech Republic)*

- *German style pilseners*
- *Bohemian pilseners*
- *Ur-Marzen or Oktoberfest (Germany)*
- *Rauchbier (smoked) (Bamberg, Germany)*

Where is Beer Now?

(SLIDE 22)

Breweries and brewpubs over the course of the last 125 years have come and gone in the US. We started high in 1887, dropped to near nothing during the prohibition of the 20's and early 30's, came back a bit and dropped down to nearly nothing again in the 70's. Fortunately, since then it has been a steady climb well beyond where it was over a century ago. As of March 2013, there are 1,124 brewpubs, 1,139 microbreweries, and 97 regional craft breweries in the US for a total of 2,360. In addition, there are 56 non-craft breweries in the US. This is the highest it has been since the 1880's.

Craft brewers currently provide an estimated 108,440 jobs in the US, including serving staff in brewpubs. Craft brewers sold an estimated 13,235,917 barrels of beer, at 31 gallons a barrel, in 2012. That is up from the 11,467,337 barrels sold in 2011. Overall US beer sales were approximately 200,028,520 barrels and imported beer sales were 27,712,665 barrels in 2012.

As of Monday, May 13 of this year our nearby city of Grand Rapids has been awarded the title of Beer City USA 2013. This is the second year in a row for that title. Last year it shared the title with Asheville, NC. It is a national online vote, and Grand Rapids received 27,005 votes out of the 50,000 votes cast. Kalamazoo came in second, and Asheville was third. Also, keep in mind that Grand Rapids is hosting the *American Homebrewings Association* convention in June of 2014 if you are interested in attending.

So drink up, there is plenty to choose from and beer is good.